Journal of Safety Education
Volume 2 Issue 1 Year 2024 Pages 7-19

P-ISSN 2986-6391 | E-ISSN 2988-3504
https://journal.unnes.ac.id/sju/index.php/jse

Hazard Identification and Safety Education on The Clothing Convection Industry Business in Semarang

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Abstract:
The clothing convection industry is one of the most popular businesses, with many growing businesses in Indonesia. In this industry, there are potential hazards that may occur either from work environment factors, the use of tools or machines, or from workers. Research objective to be achieved is to identify potential hazards in the clothing convection industry X and Y. This research used descriptive research, and the sample was two workers at the clothing convection industry X and four workers at the clothing convection industry Y for the data. The sample selection used random sampling. The data analysis technique used a narrative analysis. To minimize the number of work accidents or prevent accidents in the workplace, the identification of potential hazards is carried out through hazard analysis methods; one method is HAZOPS (Hazard Operability Studies). Based on the results of identification from workers and observation using HAZOPS method to minimize potential danger that can occur in each production with safety education using video to convey information easily for workers. Education on the use of PPE is also provided so that workers have safety knowledge and awareness at work. X and Y convection have various potential dangers in the clothing convection industry. Therefore, immediate action and attention from management are needed to minimize work accidents.

Keywords: Convection, Hazard, HAZOP, PPE, Risk

INTRODUCTION

Textiles are one of the fastest-growing industries due to higher demand from domestic and global markets. The growth of the textile industry is the main factor in increasing business in the clothing convection industry (Meilan & Muhardi, 2023). The clothing convection industry is a business that is quite popular and continues to grow in Indonesia as a source of economic income. Clothing convection is a business that mass produces clothing, whose product designs can come from customers or based on convection's own designs. In the clothing convection industry, potential hazards may occur either from work environmental factors, the use of machine tools, or from the workers themselves, which can cause work accidents (Sukmawati, 2020).

Work accidents are a combination of several factors; the most important are technical equipment, the work environment, and the workers themselves. Accidents don't occur by chance but have obvious causes. Work accidents within the context of occupational safety and health are divided into three parts: incidents, near misses, and accidents (Haworth & Hughes, 2012).

According to data from the International Labour Organization (ILO), every year, around 317 million work accidents occur with 6.300 deaths of people every day due to workplace accidents. In Indonesia, there are around 99.000 work accidents every year, and 20 of them are fatal; they cause death or lifelong disability.

Work accidents can occur due to various factors in the work environment. Hazards from the work environment include physical, biological, chemical, ergonomic, and psychosocial hazards. According to the Centers for Disease Control and Prevention (CDC), more than 13 million workers in the United States, spanning across a wide range of industries and job sectors, are potentially exposed to chemicals used through the skin. Approximately 82,000 chemicals are used in industry and it is estimated that an additional 700 new chemicals are introduced each year, creating a large potential for chemical exposure to the skin (Anderson & Meade, 2014).

A work environment that has the ability to engage workers in their performance is called a supportive work environment. Research by Raziq & Maulabakhsh (2015) states that a good work environment is an environment that can increase the production and performance of workers and will ultimately increase organizational effectiveness and also can reduce costs incurred by the company (Lestary & Harmon, 2017).

Establishing Occupational Safety and Health (OSH) in the workplace is necessary to minimize work accidents. Occupational Safety and Health is closely related to all aspects of health and safety in the workplace and has a strong focus on controlling major hazards. Occupational health and safety has become an important matter, especially in the macroeconomic and microeconomic fields, because occupational safety and health are inseparable pieces of the production of goods and services (Swaputri, 2013).

In general, the products produced in the clothing convection industry are very diverse, ranging from jackets, shirts, uniforms, t-shirts, trousers, bags, hats, and others. Products will be processed from raw materials, semi-finished, to finished products. In research conducted at one of the clothing convection industries in Semarang, precisely at the clothing convection industry X and Y. Then, the production process continues at the clothing convection industry Y which focuses on the cutting, sewing, and ironing processes. The number of workers carrying out the production process at the clothing convection industry X is two workers, while at the clothing convection industry Y there are four workers.

The production process carried out in the clothing convection industry is usually more flexible and depends more on handwork, but it also involves the use of several equipment or machines. At Y clothing convection industry, the equipment used is a cutting machine, sewing machine and iron. In clothing convection industry X, equipment that is often used is a hot gun, curing flash, oven, and press machine, with the chemicals used in the form of plastisol ink, DTF ink, emulsion, sensitizer, phosphor, thinner, and chlorine.

From the production process in clothing convection industries X and Y, multiple potential dangers and work accidents experienced by workers were found. The work accident was caused by careless or accident-prone workers who do not take safety at work seriously and not using appropriate PPE when working and also caused by the use of tools during the production process. Work accidents that occur have an adverse impact on the production process because they can hinder the progress of the production, resulting in a decrease in the quality of work. This is compounded by accidents that continue to occur every year (Kuswardana et al., 2017).

Therefore, it is necessary to prevent work accidents so that the safety and welfare of workers are guaranteed and the production process runs smoothly and safely. To minimize or eliminate the number of work accidents, preventive actions are taken by both workers and company management (Yusdinata & Bora, 2018). Work accidents can be avoided by identifying potential hazards through K3 analysis methods, one of which is HAZOPS (Hazard Operability Studies), which can be used to analyze hazards in a workplace (Wagiman & Yuamita, 2022). Thus, HAZOPS is used to identify potential hazards in X and Y clothing convection industry.

METHODS

The research design used was descriptive research. The data collection methods used were observation and interview. The research was conducted using the HAZOPS (Hazard Operability Study) table to identify hazards in the workplace. Some of the things observed involve the production process, tools, materials, work environment, potential hazards, risk of work accidents, and the application of OHS in the company.

Interviews were conducted by asking questions to workers in the company. The workers were also asked to fill out a questionnaire containing knowledge about occupational safety and occupational safety conditions in the company. Data was also documented using video and voice recorders.

The research sample participants were two workers in the clothing convection industry X and four workers in the clothing convection industry Y. The sample selection method was random sampling. The method of sample selection was random sampling. The data analysis technique used is Narrative Analysis. Data obtained from the observation and interview process is presented in a story description. Narrative data can be used as a consideration in a company. The results are presented in the form of a descriptive narrative regarding the identification of hazards and work safety conditions in the clothing convection industry. After that, a literature review is carried out to write work safety education suitable for the company's field and situation at the end of the research results.

Hazard and Operability Study (HAZOP) is a method for investigating hazards that is organised, structured, and arranged thoroughly to identify various problems that hinder the process and risks contained in a piece of equipment that can cause adverse risks to humans/facilities in the system (Rahmanto & Hamdy, 2022). To identify potential hazards in the production process of the clothing convection industry X and Y, it is necessary to know the flow of the production process first. The production process at the clothing convection industry X includes design and printing, screen printing, curing, pressing, packing, and cleaning. Meanwhile, the production process in the clothing convection industry Y includes cutting, sewing, quality checking, and ironing. After that, conduct field observations and interviews with trusted sources to identify the findings of potential hazards in the production area at clothing convection X and Y by observing all deviations that can cause work accidents (Restuputri & Sari, 2019). Other things

that need to be identified are causes, impacts, and temporary measures that must be written in the HAZOP worksheet.

The next process is to rank the hazards that have been identified by determining consequences (C) values by paying attention to severity level criteria as follows; Likelihood (L) which is the possibility of an accident occurring (Table 1) and consequences (C) or severity which is represents the severity of the injury taking into account the lost work days (Table 2).

Once the likelihood (L) and consequences (C) values for each potential hazard source are identified, the subsequent action involves multiplying these values to derive a risk level in the risk matrix. This level is crucial for prioritizing the hazards that require immediate attention for rectification (Susanto et al., 2022). Risk assessment is conducted by utilizing the risk matrix outlined in Table 3.

RESULT AND DISCUSSION

Identification of hazards that occur during the production process can be known by knowing the steps of the production process at the clothing convection industry X and Y. Production process at the clothing convection industry X is composed of design and printing, screen printing, drying, packing, and laundering. Meanwhile, at the clothing convection industry Y, the production process consists of cutting fabric, sewing, quality checking, as well as ironing, and finishing. After that, direct observations and interviews were carried out with workers as trusted informant who directly knew the process and were involved to obtain findings of potential dangers from each production process. Based on the results of observations and interviews, a total of 50 potential hazards were found with 27 potential hazards at the clothing convection industry X and 23 potential hazards at the clothing convection industry Y. The findings of potential hazards are then ranked by taking into account the likelihood and consequences criteria and categorized with a risk matrix to determine the risk level assessment of each production process. The risk matrix is a tool used to assess and evaluate risks in the occupational safety and health sector (Jensen et al., 2022). The assessment of the risk level of potential hazard findings from the production process at the clothing convection industry X can be seen in Table 4 and at the clothing convection industry Y in table 5. Based on the assessment of risk level according to the findings of potential hazards each production process at the clothing convection industry X and Y, it is known that there are no extreme category hazard levels; there are a total of 22 hazard levels in the high-risk category, 14 moderate risk, and 14 low risk with the details in Table 4. At the clothing convection industry X, there are no extreme category hazards, 11 high risk, 10 moderate risk, and 6 low risk. Meanwhile, in Table 5 risk assessment at the clothing convection industry Y, there are no extreme category hazard levels, 11 high risk, 4 moderate risk, and 8 low risk.

Based on the risk level assessment that has been carried out it is known that the production processes that have the highest level of danger in the high-risk category are the screen printing, cutting, and sewing processes. In the screen-printing process, potential dangers that occur include workers inhaling screen printing ink (plastisol) which may cause a risk of respiratory problems. Besides, exposure to screen printing ink (plastisol) on the skin increase skin irritation risks, repetitive hand movements while working which leads to developing Carpal Tunnel Syndrome (CTS), and standing positions while working for long periods of time which cause the leg muscles to become tired. Then during the cutting process, the potential dangers that occur are being hit by fabric cutting tools such as scissors or cutting machines which cause the risk of hands or fingers being injured or cut; the potential danger of falling from the cutting machine which causes the risk of bruised or bleeding feet: standing for long periods while working which causes risk of leg muscles getting tired, and there are no stair railings in the workplace so there is a risk of slipping and falling from a height. In the sewing process, potential dangers found include exposure to vibrations from the sewing machine which causes the risk of impaired concentration and Hand Arm Vibration Syndrome (HAVS), repetitive movements when sewing which causes the risk of developing Carpal Tunnel Syndrome (CTS), sitting for too long while working which causes pain in the back or waist, being pricked by a needle causes the risk of injuring the fingers, and cable damage or electrical short circuits from sewing machines which can risk causing a fire. According to these results, in the production process at the clothing convection industry X and Y, workers can be at risk of musculoskeletal disorders due to sitting without a backrest or standing for a long time and repetitive hand movements. In a study also revealed the occurrence of musculoskeletal disorders in half (49.6%) of garment workers such as low back pain, shoulder pain, and elbow pain caused by awkward postures such as long sitting and standing for a long time and doing hard labour (Khandker1 et al., 2021). Apart from that, research by Sitompul (2022) also shows that awkward hand posture and repetitive hand movements are correlated with complaints of Carpal Tunnel Syndrome (CTS) in tailors. A study also revealed that the garment industry which still use manual process increase the opportunity for workers to be exposed to irritants and allergens, causing the risk of skin irritation such as work-related contact dermatitis to also increase (Pramantara & Brathiarta, 2014). In a study by Shen (2017) mentioned that occupational diseases that commonly affect workers in various industries who use tools that produce

vibrations are hand arm vibration syndrome. Early neurological symptoms due to exposure to hand arm vibration syndrome are usually characterized by complaints of numbness in the hands or fingers, either with or without tingling (Vihlborg et al., 2017).

The findings of potential dangers were then classified based on the type of source into 9 sources of danger, including worker attitudes, electrical cables, environmental conditions, chemicals, sewing machine, pressing machine, ironing machine, fabric cutting machine, and stack of packing. The highest frequency of potential danger based on the source of the hazard was 19 findings on workers' attitudes, 7 findings on electrical cables, 7 findings on working environmental conditions, 7 findings on chemicals, and 4 findings on sewing machines. Next, processing is carried out using the HAZOP worksheet; the ranking of hazard sources is also carried out by considering the likelihood and consequences criteria, which have been multiplied to obtain the risk level on the risk matrix for each hazard source so that the hazard sources that must be repaired can be prioritized. The HAZOP worksheet and the risk level assessment based on hazard sources can be seen in Table 6. Based on Table 6, it is known that sources of danger that fall into the extreme category are worker attitudes and sewing machines. The high-category are working environmental conditions, chemicals, and ironing machines. Meanwhile, the medium-category hazard sources are electrical cables, press machines, and fabric-cutting machines, and the low-category hazard sources are packing piles.

In the source of danger of worker attitude, deviations occur in the form of the lack of awareness of the workers on safety measures or not following safe work practices, including inappropriate working positions, and not using personal protective equipment (PPE). These deviations are caused by workers themselves who lack discipline in following work instructions, low knowledge and awareness of work safety, and the absence of applicable SOPs (Standard Operational Procedures) in the workplace. Then, as a source of danger for sewing machines, deviations occur in the form of excessive vibration and noise from sewing machines, as well as sewing needles not functioning properly/damaged. This deviation is caused by rarely carrying out regular inspections and maintenance of sewing machines and other components, so they are not aware that there are parts of the sewing machine that have problems. Furthermore, at the source of dangerous working environmental conditions, deviations occur in the form of high levels of dust in the work area caused by fabric material which is fibre and easily flies. Another deviation is the absence of stair railings as a physical barrier between stairs to prevent falls from heights, this is caused by a lack of awareness of meeting security and safety standards in the workplace and installing stair railings requires additional costs. Apart from that, at the source of chemical hazards, deviations that occur are the use of chemicals such as plastisol, thinner, and liquid chlorine that are too much and not in the correct dosage. This deviation is caused by a lack of work safety awareness, a lack of understanding regarding the chemicals used, and negligence or lack of attention to the instructions for use that have been given on the label or instructions for use. Sources of danger from ironing machines can occur in the form of deviations in the form of the heat temperature of the ironing machine being higher than it should be and the sound of the ironing machine being too loud/noisy. This can be caused by incorrectly setting the temperature, a damaged sensor, and rarely maintaining the ironing machine.

The highest or extreme sources of danger have a high risk, so it requires immediate action. For high risk levels it requires attention from top management to take corrective action, for medium risk it is the responsibility of management to be specific in taking corrective action, while for low risk it must be handled with routine procedures for corrective action (Purnama, 2015). Recommendations for improvement given to sources of danger that have extreme and high risks are shown in Table 7.

Table 7. Recommendations for Improvement

Source of Danger	Risk Level	Improvement Recommendations
Employee Attitude	Extreme	- Regulation of working hours with a minimum break of 30 minutes after 4 hours of work - Safety briefing before starting work to increase awareness - Work method training for workers - Use of Personal Protective Equipment in the form of gloves, masks
Sewing machine	Extreme	- Providing rubber pads on the legs and surface of the sewing table - Regular inspection of sewing machines once a week - Applying red paint to areas of the sewing machine that are prone to needle punctures - Addition of finger restraints and eye protection on sewing machines

		- Use of Personal Protective Equipment (PPE), anti-cut, and anti-vibration gloves
Chemical material	High	- Providing danger warning labels on all chemical packaging used - Preparation and delivery of Material Safety Data Sheet (MSDS) - Use of Personal Protective Equipment (PPE) in the form of safety goggles, chemical resistant gloves, chemical respirator
Working Environment Conditions	High	- Creation of local exhaust system ventilation - Implementation of a cross ventilation system - Installing safety signs at work - Use of Personal Protective Equipment (PPE) in the form of a respirator mask
Ironing Machine	High	- Replacement of metal body irons with plastic body irons - Use heat-resistant gloves made from knitted cotton - Checking the condition of cables and ironing tools - Setting working hours to minimize exposure to ironing machine noise - Use of Personal Protective Equipment (PPE) in the form of earplugs and heat-resistant gloves

Based on the results of identification and analysis that have been carried out using HAZOPS (Hazard and Operability Studies), it is known that the potential dangers in the clothing convection industry X and Y must be immediately controlled, especially at sources of danger that fall into the extreme and high categories. One of the control measures that can be carried out to minimize potential dangers in the workplace is through safety education to workers. In this case, safety education is an administrative control that focuses on education about potential dangers that can occur in each production process and education on the importance of using Personal Protective Equipment (PPE) when they may encounter the workplace. Safety education is provided via video to convey information visually so that it is easier for workers to understand and accept the information conveyed. Education regarding potential dangers in each production process is an effort to provide workers with knowledge and understanding regarding possible risks or various types of dangers that may occur during the implementation of the production process. This must be done so that the workers are more vigilant and aware of the potential dangers and ensure that they can be productive and work safely. Employers and workers need to be aware of the hazards associated with production in clothing convection and take precautions to protect themselves from work-related illnesses and injuries (Asare et al., 2019).

Education on the use of personal protective equipment (PPE) is also provided to raise the workers' understanding about the potential risks and awareness of the importance of using PPE in their workplace. The use of Personal Protective Equipment (PPE) aims to minimize exposure to hazards that can cause injury in the workplace (Okorie et al., 2023). However, based on the results of interviews with workers, it was found that the clothing convection industry X and Y owners did not provide personal protective equipment (PPE) and workers also did not have the awareness to use PPE at work. Workplace hazards can be managed efficiently by providing personal protective equipment (PPE) (Ahmed & Raihan, 2014). Based on the Minister of Manpower and Transmigration Regulation Number 8 of 2010 concerning Personal Protective Equipment, it is regulated in Article 2 that companies are obliged to provide PPE for workers in the workplace. In addition, workers' obligations to use PPE are regulated in Article 6 of the Minister of Manpower and Transmigration Regulation Number 8 of 2010 concerning Personal Protective Equipment. The education provided on the use of PPE consists of the types of PPE that are appropriate for each potential hazard. The PPE used includes hand protection in the form of safety gloves with a chloroprene rubber palm pad that is designed to absorb vibration and combined with synthetic fibers that are resistant to cuts and punctures, chemical resistant latex type gloves that protect from exposure to chemicals, heat-resistant gloves made of leather which can protect against heat shock from the ironing machine. Then, PPE is used to protect the mouth and nose in the form of a respirator mask to protect breathing from exposure to dust and chemicals. PPE to protect the eyes in the form of safety goggles. PPE, namely foam earplugs, is used to protect the ears from noise which comes from the ironing machine. In addition, it is necessary to supervise workers because it can make workers feel supervised and required to use personal protective equipment at work (Iskandar et al., 2023).

CONCLUSION

The production process at clothing convection industry X and Y has various potential hazards. Based on the analysis results from interviews and observations using the HAZOPS (Hazard Operability Study) table, the production process with the most high-risk category is the screen printing, cutting, and sewing process. This is because the screen printing, cutting, and sewing processes can cause injuries and hinder the production process. Furthermore, there are sources of hazard that fall into the extreme category, such as worker attitudes and sewing machines. Workers' attitudes are caused by a lack of knowledge, worker awareness, and the absence of SOPs (Standard Operational Procedures) that apply in the workplace. Then, for the source of sewing machine hazards are caused by rarely conducting regular inspection and maintenance of sewing machines and other components. Meanwhile, hazard sources that are categorized as high are work environment conditions, chemicals, and ironing machines. Work environment conditions due to irregularities in the absence of stair railings as a physical barrier between stairs to prevent falls from height. Chemical hazards occur due to the use of chemicals that do not match the dosage. Ironing machine conditions are caused by incorrect temperature settings, damaged sensors, and infrequent ironing machine maintenance. This is all due to the workers' lack of knowledge and safety awareness. Therefore, immediate action and attention from top management is needed to take corrective action. It is also necessary to control the risk of hazards to minimize work accidents through safety education to workers.

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APPENDIX

Table 1. Likelihood Criteria

Level	Criteria	Description
5	Almost certain	More than once a month
4	Likely	More than once a year
3	Moderate	More than once in three years
2	Unlikely	Occurs once in five years
1	Rare	Less than once in five years

Table 2. Consequences/Severity Criteria

Level	Criteria	Description
5	Catastrophic	Resulting in fatalities and severe losses, it can even stop business activities, as well as loss of working days forever.
4	Major	Causing severe injuries and major losses, and requiring rest or loss of work days for more than 3 days.

3	Moderate	Causing serious injury, moderate loss, and requiring rest or loss of working days for less than 3 days.
2	Minor	Causes minor injuries, minor losses and can still work the same day or shift.
1	Insignificant	It is a minor injury, does not cause serious consequences, does not interfere with work activities, and does not cause loss of working days.

Table 3. Risk Matrix

SCALE		CONSEQUENCES				
		1	2	3	4	5
LIKELIHOOD	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

Risk Level
Extreme Risk
High Risk
Moderate Risk
Low Risk

Table 4. Hazard Identification in Clothing Convection X

No	Process	Hazard	Risk	Hazard Sources	L	C	S	Risk level
1	Design	The viewing distance between the eyes and the computer is too close	Eyes exposed to radiation	Worker Attitude	5	2	10	High
		Unergonomic sitting position	Back, neck and shoulder pain, posture problem	Worker Attitude	4	2	8	High
		DTF Chemical ink exposed to skin	Skin allergy/irritation	Worker Attitude	3	2	6	Moderate
		The power cord is always plugged in	Electrical short circuit and electric shock	Electrical wiring	2	1	2	Low
		Inhaling DTF powder	Respiratory disorders	Chemical	3	2	6	Moderate
		Exposure of DTF powder to skin	Exposure of DTF powder to the skin	Chemical	3	2	6	Moderate
2	Afdruk	When mixing bremol, workers do not use PPE	Skin allergy/irritation	Chemical	4	2	8	High
		In the hot gun drying process, workers do not protect their arms and hands.	Burns	Worker Attitude	3	2	6	Moderate
		During the screen irradiation process, workers do not maintain a safe distance.	Burns	Worker Attitude	2	2	4	Low
		Cable hanging	Electrical short circuit and electric shock	Electrical wiring	2	1	2	Low
		Worker's position is not ergonomic	Back, neck and shoulder pain, posture problem	Worker Attitude	3	1	3	Low
3	Screen	Workers inhale plastisol	Respiratory disorders	Chemical	5	2	10	High

	Printing	Exposure of plastisol to the skin	Skin irritation	Chemical	4	2	8	High
		Repetitive hand movements while working	Carpal Tunnel Syndrome (CTS)	Worker Attitude	4	2	8	High
		Long periods of standing while working	Leg muscles fatigue, stiffness, tingling, joint pain	Worker Attitude	4	3	12	High
4	Curing	Heat exposure from hot guns, curing flash, and ovens	Burns	Worker Attitude	3	2	6	Moderate
		Cable hanging	Electrical short circuit and electric shock	Electrical wiring	2	1	2	Low
		Long periods of standing while working	Leg muscles fatigue, stiffness, tingling, joint pain	Worker Attitude	3	2	6	Moderate
5	*Finishing*	distance between hand and press machine is too close	Hand pinched by press machine	Press Machine	1	4	4	Moderate
		heat exposure of press machine	Burns	Press Machine	2	1	2	Moderate
		Long periods of standing while working	Leg muscles fatigue, stiffness, tingling, joint pain	Worker Attitude	4	2	8	High
6	*Packing*	Fabric dust inhalation	Respiratory disorders	Work Environment	4	2	8	High
		Stack of Clothes is too high	Hit by a pile of packing clothes	Stack of Objects	3	2	6	Moderate
		Worker's position is not ergonomic	Back, neck and shoulder pain, posture problem	Worker Attitude	4	2	8	High
7	*Cleaning*	Inhalation of thinner M4, M3, and chlorine liquid	Respiratory disorders	Chemical	4	3	12	High
		Not wearing long clothes and gloves	Skin irritation	Chemical	2	3	6	Moderate
		Worker's position is not ergonomic	Pain in the back, legs, hands	Worker Attitude	3	2	6	Low

Table 5. Hazard Identification in the Clothing Convection Y

No	Process	Hazard	Risk	Hazard Sources	L	C	S	*Risk level*
1	Cutting	Fabric dust inhalation	Respiratory disorders	Work Environment	2	3	6	Moderate
		Exposed to cutting tools	Hand or finger cuts and scrapes	Cutting machine	3	3	9	High
		Fall of cutting machine	Leg bruising/bleeding	Cutting machine	1	4	4	High
		Long periods of standing while working	Leg muscles fatigue, stiffness, tingling, joint pain	Worker Attitude	5	2	10	High
		Cables are scattered and hang untidy	Tripping over wires and getting electrocuted	Electrical wiring	3	2	6	Moderate
		No stair railing	Slips and falls from heights	Work Environment	2	4	8	High

		The roof is too low	Head bump	Worker Attitude	4	1	4	Low
2	Sewing	Exposure to vibration	Impaired concentration, hand arm syndrome	Sewing machine	5	2	10	High
		Repetitive motion while sewing	Carpal tunnel syndrome (CTS)	Worker Attitude	5	1	5	High
		Sitting for too long	Pain in the back, neck and waist.	Worker Attitude	4	2	8	High
		Noise exposure	Hearing damage	Sewing machine	2	1	2	Low
		Fabric dust inhalation	Respiratory disorders	Work Environment	1	3	3	Low
		Needle puncture	Injured finger	Sewing machine	3	3	9	High
		Cables are scattered and hang untidy	Tripping over wires and getting electrocuted	Electrical wiring	2	3	6	Moderate
		Exposure to broken needle fragments	Eye injury	Sewing machine	1	4	4	Moderate
		Wiring damage and electrical short circuit of the machine	Fire	Electrical wiring	1	5	5	High
3	Quality Control	Exposed to cutting tools	Hand or finger cuts and scrapes	Worker Attitude	2	2	4	Low
		Exposure to fabric fiber fragments	Eye injury	Work Environment	2	2	4	Low
		Fabric dust inhalation	Respiratory disorders	Work Environment	2	2	4	Low
4	Ironing and Finishing	Heat exposure	Burns on the skin	Ironing machine	3	3	9	High
		Damage to wiring or electrical components of the machine	Electric shock or fire	Electrical wiring	1	3	3	Low
		Noise exposure	Hearing damage	Ironing machine	1	3	3	Low
		Long periods of standing while working	Pain in the legs	Worker Attitude	5	2	10	High

Table 6. HAZOP Worksheet

No	Source of Hazard	Freq	Deviation	Cause	Consequences	Action	L	C	S	Risk Level
1	Worker Attitude	19	- Workers act unsafely or inappropriately to procedures. - Work position is not suitable. -Workers don't use PPE (masks, gloves, earplugs, safety shoes).	- Lack of discipline in worker attitudes - Low safety knowledge and awareness - No procedures in place at the workplace	- Eyestrain - Head bump - Injured limbs - Skin irritation - Pain, fatigue, and muscle tightness - Affected Carpal Tunnel Syndrome (CTS) - burns	- Providing OHS education and training to workers. - Provide education on the correct use, and use of PPE when working.	5	3	15	***Extreme***

2	Electrical Wiring	7	- Electrical cables do not operate according to specifications or desired conditions. - Electrical cables are pinched and scattered where they should not be. - Unstable voltage.	- Rare inspection - Lack of safety awareness - Excessive use of electrical voltage from machine use.	- Tripped - Electrical short circuit - Electrocuted	- Conduct regular checks on electrical cables to ensure that the insulation and conductors are not significantly damaged. - Placing power cables safely, protected from physical damage, and not interfering with traffic or activities that could potentially damage the cables.	3	2	6	Moderate
3	Environmental Conditions	7	- Dust levels in the work area exceed the threshold value - No stair railing	- Material consists of fabric which is fiber and easily blown away. - Lack of safety awareness - Installation of stair railings requires additional costs	- Respiratory distress - Eye injury - Slipping or falling from a height	- Use of efficient dust capture systems such as industrial vacuum cleaners, and machine settings that reduce dust release. - Installing stair railings that meet safety standards.	5	1	5	High
4	Chemicals	7	- Use of too much screen printing ink or plastisol, ink spills, or leaks. - Spillage of M3 and M4 thinner, and chlorine liquid.	- Lack of work safety awareness - Lack of understanding of the chemicals used - Negligence or lack of attention to the instructions for use that have been given on the label	- Allergies, irritation and inflammation of the skin such as redness and dry skin - Respiratory distress	- Use masks and gloves when working. - Comply with the rules for the correct and proper use of screen printing ink. - Placing screen printing ink in a safe place.	4	2	8	High
5	Press Machine	2	The heat temperature of the press is higher than it should be. Not operating according to its function.	- Incorrect temperature setting - Damaged sensor - Mechanical damage - Rarely perform press machine maintenance	- Hand squeezed or pinched by the press - Heatstroke - Easy fatigue	- Education about proper usage and appropriate temperature settings. - Repair broken components. - Monitor and measure press performance regularly.	2	3	6	Moderate
6	Packing Pile	1	Clothes packing stacked too high	- Lack of safety awareness	- Hit by a pile of packing clothes	Place the packed clothes in a safe place away from activities that could potentially cause the pile to fall over.	3	1	3	Low
7	Fabric Cutting Machine	2	Not placing the fabric cutting machine in a safe place	- Lack of safety awareness - Instability and improper placement of machinery	- Cuts/injuries to fingers - Falling cutting machine	Place the cutting machine on a stable and strong workbench away from the edge of the table, and use PPE.	2	3	6	Moderate
8	Sewing Machine	4	- Excessive vibration and noise from the sewing machine. - The sewing needle on the sewing machine is not functioning properly/damaged.	- Mechanical damage - Rare maintenance of the sewing machine and other components.	- Distracted concentration - Fatigue - Hand arm syndrome - Needle puncture - Needle fragments hurt the eye - Hearing damage	- Regular machine maintenance and repair checks. - Use of vibration-damping mats under the sewing machine. - Use of appropriate ear protection. - Ensuring proper needle and thread settings. - Use of appropriate PPE.	3	4	12	Extreme
9	Ironing Machine	2	The ironing machine is hot and the noise is too loud.	- Skin burns - Fire - Hearing damage	- Skin burns - Fire - Hearing damage	Conduct regular inspections and repair or replace damaged components.	3	3	9	High